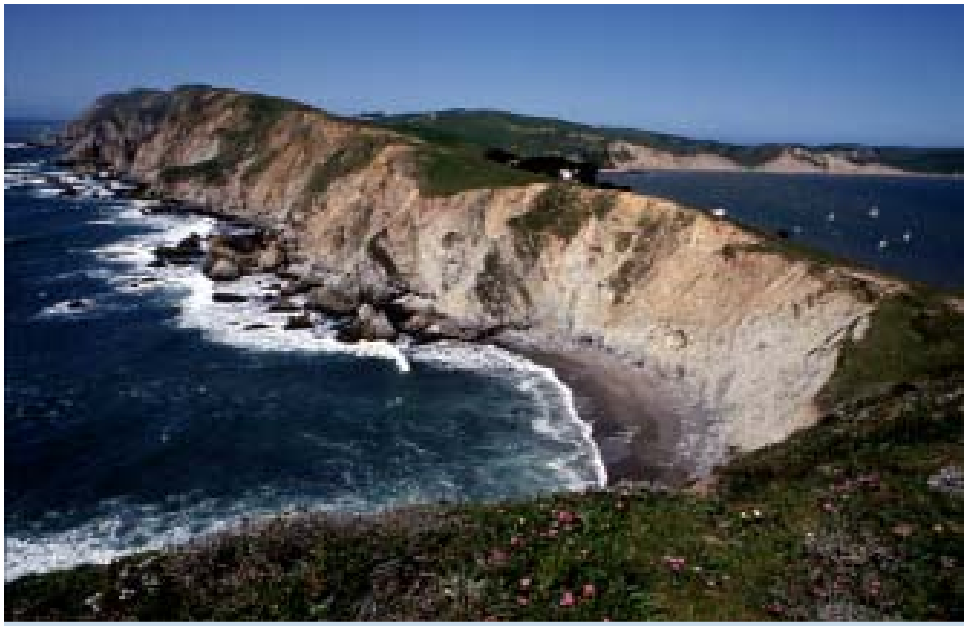
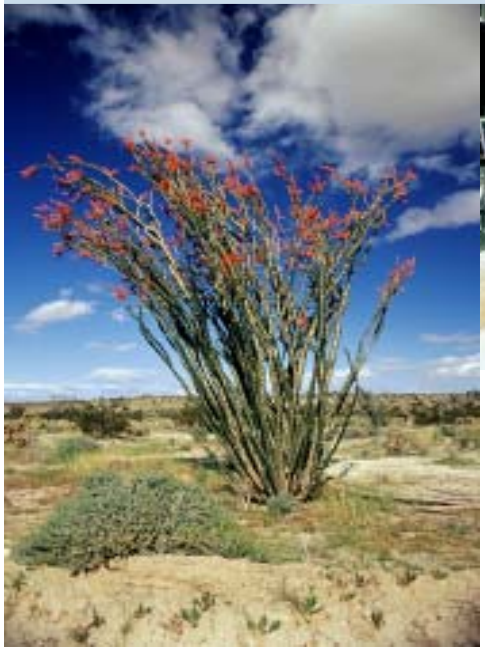
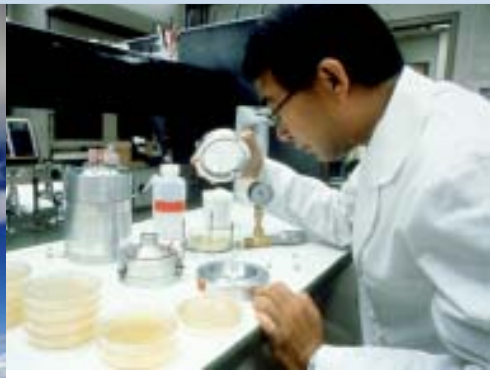


Science to Achieve Results (STAR) Environmental Research Seminar

October 8 & 9, 2003/U.S. EPA Region 9: Pacific Southwest





U.S. EPA, Pacific Southwest/Region 9
75 Hawthorne Street
San Francisco, CA 94105

EPA-909-5-03-001

STAR Agenda - Wednesday, October 8

8:00 Registration

8:45 Introductions and Seminar Logistics

9:00 Welcome — Laura Yoshii, Deputy Regional Administrator, U.S. EPA Pacific Southwest Region

9:25 ORD Opening — William Farland, Chief Scientist in the Office of the Agency Science Advisor

9:45 BREAK

SESSION 1: Clean Air

Chair: WinonaVictery

10:00 John Froines, UC Los Angeles: *"Recent Progress in Particle Research at the Southern California Particle Center and Supersite: the Role of Ultrafine Particles and Traffic"*

10:30 Kent Pinkerton, UC Davis: *"Health Effects of Concentrated Ambient Particles for the Central Valley of California"*

11:00 Michael Lebowitz, University of Arizona: *"Long-Term Morbidity and Mortality Related to Exposures to Particulate Matter and Associated Pollutants"*

11:30 Mike Kleeman, CA Institute of Technology: *"Simulating Air Quality in the San Joaquin Valley with a Source-Oriented Externally Mixed Airshed Model"*

12:00 LUNCH

SESSION 2: Healthy Communities & Ecosystems

Chair: Jan Baxter

1:00 Mary Kay O'Rourke, University of AZ: *"Children and Pesticide Exposure at the U.S.-Mexico Border"*

1:30 Ashok Mulchandani, UC Riverside: *"Fast Screening and Detailed Identification of Organophosphate Nerve Agents Using Microchips"*

2:00 Henry Gong, UC Los Angeles: *"Modulation of Allergic Airway Responses by Environmental Tobacco Smoke"*

2:30 Paul Rochelle, Los Angeles Metropolitan Water District: *"Development and Evaluation of Procedures for Detecting Infectious Microsporidia in Source Waters"*

3:00 BREAK

3:15 Robert Richmond, University of Guam: *"Integrating Coral Reef Eco-system Integrity and Restoration Options with Watershed-Based Activities in the Tropical Pacific Islands and the Societal Costs of Poor Land-use Practices"*

3:45 Jefferey Guyse, Cal Poly Pomona: *"Assessing Preferences for Environmental Decisions with Long-Term Consequences"*

4:15 Bill Lasley, UC Davis: *"Environmental Endocrine Disruption in Avian Wildlife"*

4:45 Jacimaira Batista, Univ. Nev. Las Vegas: *"The Fate and Transport of Perchlorate in a Contaminated Site in the Las Vegas Valley"*

5:15 Adjourn

Thursday, October 9

9:00 Summary of First Day, Logistics

SESSION 3: Clean Land

Chair: Raymond Chavira

9:15 Asa Bradman, UC Berkeley: *"A Longitudinal Birth Cohort Study of Exposures and Health of Migrant Children Living in an Agricultural Community"*

9:45 Gary Shaw, Cal. Birth Defects Monitoring Program, March of Dimes: *"Gene-Environment Interactions and Human Malformations"*

10:15 David Gardiner, UC Irvine: *"Frog Deformaties: Role of Endocrine Disruptors During Development"*

10:45 BREAK

11:00 Robert Kagan and Dorothy Thornton, UC Berkeley: *"The Role of General Deterrence in Corporate Environmental Behavior"*

11:30 Phillip Fine, University of Southern California: *"The Contribution of Biomass Combustion to Ambient Fine Particle Concentrations in the United States"*

12:00 LUNCH

SESSION 4: Clean Water

Chairs: Eugenia McNaughton and Amy Wagner

1:30 Susan Anderson, UC Davis: *"Synthetic Indicators of Salt Marsh Condition and the Mission of the PEEIR Consortium"*

2:00 Geoffrey Schladow, UC Davis: *"Characterizing Contaminant Issues in San Pablo Bay and Its Environs"*

2:30 Kamini Singha, Stanford University: *"Applicability of Electrical Estimate Subsurface Heterogeneity of Hydrogeologic Parameters"*

3:00 Adjourn

Welcome - Laura Yoshii

Laura Yoshii is currently the Deputy Administrator for U.S. EPA's Pacific Southwest Region. Prior to her current assignment, she held various managerial assignments including Director of the Waste Management Division with responsibility for RCRA Hazardous Waste, Solid Waste and Underground Tank programs; Director of the Cross Media Division with responsibility for Pesticides and Toxics, Tribal, Outer Pacific Islands, Federal Facilities, Community-Based and Environmental Justice programs, and an intergovernmental managerial assignment with the California Department of Health Services, helping to organize and implement California's hazardous waste program.

Prior to joining U.S. EPA, Ms. Yoshii worked in local government implementing various social service programs. Ms. Yoshii received her BA from the University of California, Berkeley and her Masters in Public Administration from California State University at Hayward.

ORD Opening - William Farland

Dr. William H. Farland is currently the Acting Deputy Assistant Administrator for Science in the U.S. Environmental Protection Agency's Office of Research and Development (ORD). Dr. Farland was also recently appointed Chief Scientist in the Office of the Agency Science Advisor. Prior to that appointment, he was the Director of the ORD's National Center for Environmental Assessment (NCEA) which has major responsibility for conducting chemical-specific risk assessments in support of EPA regulatory programs, the development of Agency-wide guidance on risk assessment, and research to improve risk assessment. Dr. Farland's 20-year federal career has been characterized by a commitment to developing national and international approaches to the testing and assessment of the fate and effects of environmental agents. He has led the EPA's extensive reassessment of the exposure and health effects of dioxin and related compounds.

Dr. Farland holds a Ph.D. from UCLA in Cell Biology and Biochemistry. He serves on a number of executive-level committees and advisory boards within the Federal government. He is also a member of the Scientific Advisory Council of the Risk Sciences and Public Policy Institute, Johns Hopkins University School of Hygiene and Public Health, a public member of the American Chemistry Council's Strategic Science Team for its Long Term Research Program and several other industry- and university-based Science Advisory Panels. In 2002, Dr. Farland was recognized by the Society for Risk Analysis with the "Outstanding Risk Practitioner Award." He continues to teach and publish and has been a member of the Editorial Board for *Risk Analysis* since 1987 and for *Environmental Health Perspectives* since 1997.

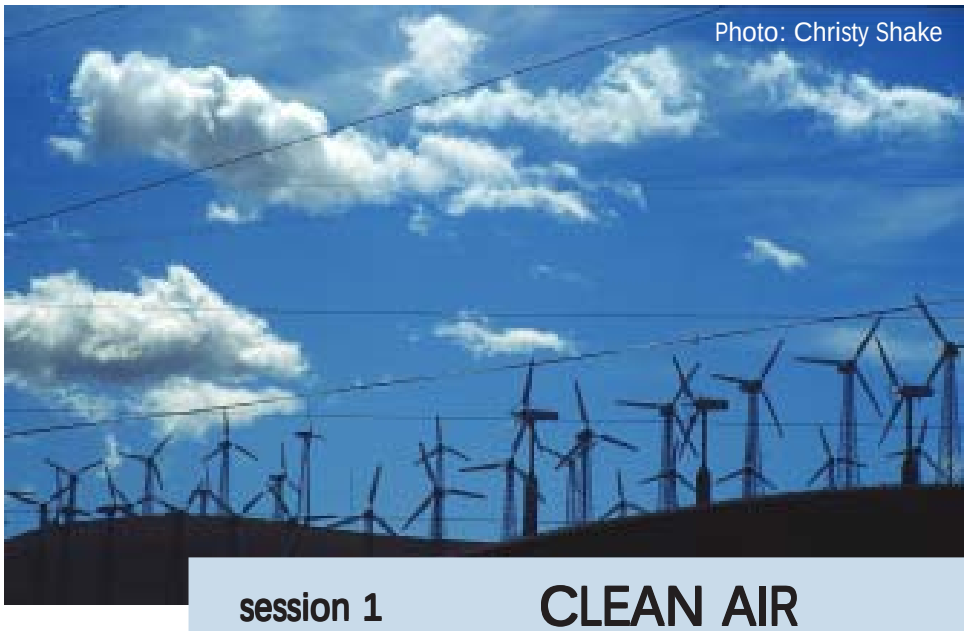


Photo: Christy Shake

session 1 CLEAN AIR

John Froines: "Recent Progress in Particle Research at the Southern California Particle Center and Supersite: the Role of Ultrafine Particles and Traffic"

The Southern California Particle Center and Supersite (SCPCS) is one of the Centers established with funding from EPA. Additional funding derives from the California Air Resources Board, and the South Coast Air Quality Management District. Participating faculty are from UCLA, USC, UC Riverside, UC Davis, UC Irvine, Rancho Los Amigos, Sonoma Technology, Michigan State University, and the University of Tsukuba, Japan. Faculty within the SCPCS comprise a wide range of disciplines including toxicology, epidemiology, biostatistics, immunology, pharmacology, medicine, atmospheric sciences, atmospheric and environmental chemistry, exposure assessment, and aerosol science.

The two themes of the SCPCS research are: (1) Mobile Source Pollution and Health Effects; and (2) Identification of the Important Physical/Chemical Characteristics of Particulate Matter (PM) Responsible for the Adverse Health Effects Associated with PM. By linking exposure assessment/PM characterization with toxicological, epidemiological and human clinical studies, we can address how PM affects human health and what sources are important. The research programs are subdivided into three areas:

A. Studies emphasizing the biological/biochemical mechanisms of health effects in relation to PM physical/chemical characteristics;
B. Studies of emission sources and related adverse health effects;
C. Varying spatial/temporal patterns of PM and resulting health effects.

The SCPCS has made important findings in its research activities. I will discuss the integration of our exposure assessment activities with studies of biological/chemical mechanism, the linkage with the epidemiological investigations in the Children's Health Study and Dr. Beate Ritz's reproductive studies, and the clinical research of Rancho Los Amigos. Our results suggest an important role for ultrafine PM (0.01-0.1 µm) in the initiation of adverse health effects.

Dr. Froines received a B.S. in Chemistry from the University of California, Berkeley and an M.S. and Ph.D. in Physical-Organic Chemistry from Yale University. He has held several state and national directorships and currently holds multiple positions including Director of the UCLA Center for Occupational and Environmental Health, Director of the Southern California Particle Center and Supersite, and Director for the newly formed South Coast AQMD Consortium on Asthma and Air Pollution.

Dr. Froines' air-related research includes the health effects of particulate matter, lung cancer and non-cancer health effects attributable to air pollution and the biochemical mechanism of the carcinogenicity of toxic air contaminants. In addition to his research on air pollution, he has conducted research on the carcinogenicity of arsenic, beryllium and chromium. Dr. Froines has received numerous honors including recent citations for his contributions from the Governor of California and the head of CAL/EPA.

Kent E. Pinkerton: "Health Effects of Concentrated Ambient Particles for the Central Valley of California"

Our research addresses the question: "How does exposure to concentrated particulates from two agricultural sites affect certain types of protective cells in the lungs?" Young adult rats were exposed in Fresno or Davis, CA to filtered air, to combined ultrafine and fine fractions of Particulate Matter (PM) enhanced 20-fold over ambient levels, or to coarse particles enhanced 40-fold over ambient. Exposures were 4 hours/day for 3 consecutive days. PM was concentrated using an aerosol concentrator that preserved chemical composition, size distribution and surface morphology. PM mass and particle numbers were measured continuously during animal exposures. PM was enriched primarily with nitrate, organic carbon, metals and silicon. Bronchoalveolar lavage (BAL) was performed following exposure. Viability, total cell number, and the proportion of protective macrophages, neutrophils, and lymphocytes in the BAL were determined.

Results showed that protective cell viability was signifi-cantly reduced during 4 of 6 weeks exposure in Fresno to fine/ultrafine particles. The number of neutrophils was significantly increased during 4 of 4 weeks following expo-sure to coarse particles. The decrease in BAL cell viability in the PM-exposed animals is suggestive of cellular membrane damage, possibly through a transition metal-catalyzed oxidative stress, while the increase in neutrophils in the BAL from the PM-exposed animals is suggestive of a mild inflammatory response. These observations demonstrate that

exposure to enhanced concentrations of ambient particles (both fine and coarse) is associated with significant effects in the lungs of healthy adult animals.

Dr. Pinkerton completed his Ph.D. in Pathology at Duke University. In 1986, he joined the Department of Anatomy, Physiology and Cell Biology in the School of Veterinary Medicine at UC Davis. Dr. Pinkerton serves as director of the Center for Health and the Environment at UC Davis. He is a member of the American Thoracic Society and Society of Toxicology.

Dr. Pinkerton's research interests are the health effects of environmental air pollutants on lung structure and function; the interaction of gases and airborne particles within specific sites and cell populations of the lungs in acute and chronic lung injury; and the effects of environmental tobacco smoke on lung growth and development.

Michael Lebowitz and M.K. O'Rourke: "Long-Term Morbidity and Mortality Related to Exposures to Particulate Matter and Associated Air Pollutants"

The primary objective of this project was to determine the chronic cardiopulmonary morbidity in normal and susceptible persons associated with indoor and ambient/outdoor exposures to particulate matter (primarily PM_{10}). Measures of cardiopulmonary disease in a long-term study of a representative Tucson, AZ population of over 3000 subjects, followed for 26 years, were related to their PM exposures. Historical and environmental data and NHEXAS (indoor/outdoor lowflow impactor) data were used to obtain the estimates of total air exposures to PM.

Five factors affect indoor PM_{10} concentrations: 1) indoor sources, 2) outdoor concentration, 3) household ventilation, 4) resuspension, and 5) air filters. Indoor PM_{10} concentrations ranged up to 211.7 $\mu g/m^3$, with a median of 31.3 $\mu g/m^3$. Outdoor values ranged up to 115.9 $\mu g/m^3$, with a median of 24.5 $\mu g/m^3$.

A significant exposure-response relationship between PM concentration and the development of pulmonary morbidity (disease and symptoms) was found. Specifically, chronic bronchitis was 1.45 (i.e., 45% more) prevalent in those with higher PM_{10} exposures. There was a good likelihood that PM exposures are related to cardiovascular disease as well, as we found that new heart problems during the study were 4.6 times more likely in those with higher PM exposures. These results were found having taken into account age, gender and smoking.

Dr. Lebowitz has a Ph.D. in Epidemiology & Environmental Health Sciences, with a minor in Biostatistics, and a Ph.C. in Preventive Medicine with a minor in Biomedical Sciences from the University of Washington (Seattle). He also has an M.A. in Biostatistics minor in Demography from the University of California, Berkeley. He has over 30 years of experience in public health, epidemiology, biostatistics, environmental epidemiology and other environmental

health sciences. He helped write EPA Air Quality Criteria documents, WHO Environmental Health Criteria series, WHO/Euro monographs, and similar reports for other governments. He is currently Associate Editor of *Toxicology and Industrial Health* and on the Editorial Boards of *Archives of Environmental Health*, *Indoor Air*, and other journals.

He has been the Principal Investigator (PI) of many grants in environmental health sciences & epidemiology, and in cardio-pulmonary epidemiology, including two longitudinal cohort studies and the AZ National Human Exposure Assessment Survey (NHEXAS), its Border Extension (NAFTA), and the STAR grant on which he is reporting. The NHEXAS grants include multimedia exposure assessments for metals and particulate matter, pesticides, VOCs, and PAHs. He is also currently the PI of a CDC Prevention Research Center and other grants.

Michael J. Kleeman: "Simulating Air Quality in the San Joaquin Valley with a Source-Oriented Externally Mixed Airshed Model"

The focus of this research project is to improve the accuracy of air quality models in order to link mitigation strategies with health outcomes. The United States Environmental Protection Agency (EPA) has formulated National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) with aerodynamic diameters less than 2.5 μm ($PM_{2.5}$) to protect sensitive members of the public from negative health effects. $PM_{2.5}$ concentrations in California's San Joaquin Valley rank among the highest in the nation and routinely exceed $PM_{2.5}$ NAAQS values. Strategies to reduce $PM_{2.5}$ concentrations are difficult to design because many of the important atmospheric formation pathways are highly non-linear and difficult to model.

A new generation of source-oriented air quality models are currently being developed that can overcome this problem. In this presentation, the UCD-CIT source-oriented air quality model will be used to identify source contributions to primary and secondary $PM_{2.5}$ concentrations during a typical winter air pollution episode in the San Joaquin Valley. The implications of model results for potential control strategies will be discussed.

Dr. Kleeman holds a B.A.Sc. degree in Mechanical Engineering from the University of Waterloo, a M.S. degree in Environmental Engineering Science from the California Institute of Technology, and a Ph.D. degree in Environmental Science from the California Institute of Technology. His research is focused on the study of urban and regional air quality problems with an emphasis on the size and composition of atmospheric particles and gas-to-particle conversion processes. Current projects include source apportionment of ultrafine particulate matter, evaluation of urban air quality in the presence of climate change, and development of source-oriented air quality models.


Photo: Gerry Hiatt

session 2 HEALTHY COMMUNITIES & ECOSYSTEMS

Mary Kay O'Rourke, P. Sánchez Lizardi, A. Aguirre, and M.D. Lebowitz: "Children and Pesticide Exposure at the US-Mexico Border"

Children are a sensitive sub-population particularly vulnerable to environmental contaminants (e.g., pesticides) that may affect their health. We evaluated exposure in small farming communities near Yuma, AZ using a combination of approaches. We have evaluated cross-border product use, modeled pesticide application data and, under EPA STAR auspices, employed a multimedia, multipathway, exposure assessment evaluating 8-10 widely used organophosphate pesticides (OPs). In all, we have interacted with 564 families with young children using door-to-door and targeted recruitment strategies (Head Start, Migrant Head Start and WIC clinics). Our community partnerships and use of "Promotoras" are integral to the field success of this program.

Factors promoting exposure were intermittent, thus elevation in urinary biomarkers of pesticide exposure varied widely through time for a single child. Exposures through all routes examined indicate that ingestion of food and dust dominate the aggregate exposure means. Mean pesticide exposures were well below oral reference values. Current work is focused on specific hand-to-mouth activities and their relationship to children's exposure. The more active the child, the greater the concentration of urinary pesticide biomarkers.

Dr. O'Rourke is an Associate Professor of Public Health Research, and a Research Associate Professor in Medicine at The University of Arizona. She is an environmental scientist working in both Epidemiology and the Environmental and Occupational

Health areas of the Mel and Enid Zuckerman Arizona College of Public Health

Dr. O'Rourke has conducted interdisciplinary environmental research for over 25 years, working on exposure assessment surveys investigating metal, pesticide, VOC and PAH exposures. These studies include the National Human Exposure Assessment Survey, the Arizona Board Survey, two surveys examining pesticide exposure among children in Yuma County, AZ and a pesticide exposure in the Gila River Indian Community. She has extensive experience in designing and implementing exposure assessment field surveys, quality assurance programs and the data processing protocols for large studies. She is also a member of the Respiratory Sciences Center where she evaluates human symptom response to bioaerosols (pollen, mold, house dust mites) using the tools of exposure assessment.

Ashok Mulchandani: "Fast Screening and Detailed Identification of Organophosphate Nerve Agents Using Microchips"

The lack of sensors to perform measurement/detection of organophosphates (OPs) limit the ability to routinely monitor these highly neurotoxic but widely used pesticides/insecticides. Miniaturized analytical devices, based on microfluidic chips, are attracting growing interest due to their enhanced performance, faster response, high degree of integration, substantial reduction in the overall weight and size, and sample/reagent consumption.

Two chip-based microanalyzers were developed and evaluated for detailed identification and quantitative determination of OP nerve agents. In the first system, a micromachined capillary electrophoresis chip was coupled to a thick-film amperometric detector for the direct and rapid determination of ppm levels of *p*-nitrophenyl substituted OP pesticides such as ethyl parathion, methyl parathion, fenitrothion and paraoxon. In the second system, the chip-based microanalyzer was integrated with a contactless conductivity detector to detect the phosphonic acid products produced by a hydrolysis of the OP nerve agents.

Dr. Mulchandani is Professor and Chair in the Department of Chemical and Environmental Engineering at the University of California, Riverside. He obtained his Ph.D. in Chemical Engineering from McGill University, Montreal, Canada. He has authored/co-authored over 200 scientific publications including peer-reviewed papers, reviews, presentations and patents. He has co-edited four books/symposia proceedings on the subject of biosensors.

Dr. Mulchandani is an authority in the area of development of biosensors for detection and identification of chemical and biological warfare agents and biological-based processes for detoxification/degradation of chemical warfare agents. He has published numerous papers and presented many invited talks on the topic of biosensors for determination of chemical warfare agents. Dr. Mulchandani is the recipient of

the National Science Foundation's Research Initiation Award and the Department of Energy's Faculty Research Participation Award. For more details please see www.engr.ucr.edu/~adani.

Henry Gong, Jr. and David Diaz-Sanchez: "Modulation of Allergic Airway Responses by Environmental Tobacco Smoke"

Environmental tobacco smoke (ETS) is implicated in epidemiological studies as a risk factor for causing and/or worsening allergic airways disease. We directly evaluated the airway interaction of ETS and allergen by exposing children and adults with allergic rhinitis to either clean air or ETS for 2 hours in an environmental chamber, followed by nasal instillation of ragweed allergen 2 hours later. Nasal lavage (NL) with cellular and mediator assays were performed before and after each intervention.

ETS significantly enhances allergen-specific IgE responses and histamine concentrations — all characteristic of an active allergic response and exacerbation. Children had generally greater nasal allergic responses than adults. Age-specific outcomes were supported by concurrent ETS studies in a mouse model. In summary, ETS + allergen enhances allergen-specific IgE, Th2 cytokines, and histamine release, suggesting that the two inhaled agents strongly interact to exacerbate allergic airways disease. Although we evaluated only the upper airway, these events likely occur in the lower airways as well. Importantly, children appear to be more sensitive and mount a greater allergic response to ETS than allergic adults.

Dr. Gong, M.D., FCCP, FACP, received his B.A. (Biology) from the University of the Pacific, Stockton, CA, and his M.D. from the University of California, Davis. After his tenure at UCLA Hospital as Professor of Medicine, Dr. Gong became Chief of the Environmental Health Service at Los Amigos Medical Center. Dr. Gong has written over 250 papers, chapters, or books on respiratory-related and air pollution topics, including ozone-related health effects. Dr. Gong is/was on the Editorial Board of the *Journal of Clinical Pharmacology, The American Journal of Critical Care,* and *Archives of Environmental Health*, and a reviewer for over 20 clinical and environmental journals.

Currently, Dr. Gong is the Director and Principal Investigator of the Southern California Children's Environmental Health Center, which is co-funded by the U.S. EPA and NIEHS. His major clinical research involves controlled human exposures to concentrated ambient particulates, with and without copollutant gas, and diesel exhaust (funding from the Health Effects Institute and the EPA-supported Southern California Particle Center and Supersite).

Paul A. Rochelle: "Development and Evaluation of Procedures for Detecting Infectious Microsporidia in Source Waters"

Microsporidian pathogens, particularly *Enterocytozoon bieneusi* and *Encephalitozoon* spp., represent a significant public health concern. Because many animals carry

microsporidia it is possible that untreated source waters may become contaminated and consequently serve as a route of transmission to humans. However, there are no routine methods for detection of *microsporidia* in water and very little is known about their occurrence. There is a critical need to determine the role drinking water plays in the epidemiology of this group of parasites. The overall objectives of this study were to develop methods to recover *microsporidia* from water, determine the viability and infectivity of detected spores, and to assess the occurrence of *microsporidia* in untreated source waters.

This project has made considerable progress in the development and evaluation of methods for detecting environmental *microsporidia* spores and measuring their infectivity. Following optimization, these techniques can be used to assess the extent of *microsporidia* contamination in water, which will allow the water industry and public health officials to determine whether water represents a significant route of transmission for these parasites.

Dr. Rochelle is a Principal Microbiologist and Microbiology Development Team Manager in the Water Quality Section at the Metropolitan Water District of Southern California. He has a B.S. in Microbiology from Manchester Polytechnic in the United Kingdom and a doctorate in Microbiology from the University of Wales Institute of Science and Technology. Since joining Metropolitan in 1995, he has developed new methods for the detection and identification of *Cryptosporidium parvum* and other pathogens in water and pioneered the use of cell culture within the water industry to measure infectivity of *Cryptosporidium*. He is the co-inventor of Metropolitan's first patent on a *Cryptosporidium* detection method.

Dr. Rochelle has authored over 35 peer-reviewed papers, numerous book chapters and a book on applications of molecular techniques in environmental microbiology. He currently serves on the American Water Works Association's Microbial Contaminants Research and Organisms in Water Committees, the Standard Methods for the Examination of Water and Wastewater Committee, an NSF/ETV bioterrorism expert panel, and is a member of the National Drinking Water Advisory Council Candidate Contaminant List Process Workgroup.

Robert H. Richmond, Eric Wolanski, Michael Hamnett: "Integrating Coral Reef Ecosystem Integrity and Restoration Options with Watershed-based Activities in the Tropical Pacific Islands and the Societal Costs of Poor Land-use Practices"

Coral reefs are highly diverse, productive and complex ecosystems. They build tropical islands and land masses, protect their shores from coastal erosion and wave damage, support fisheries of cultural and economic value, are a repository for natural products of biomedical value, and are truly museums of the world's tropical marine biodiversity. While coral reefs are relatively robust and have survived millions of years of natural disturbances, anthropogenic influences are a major concern for the sustainability of these important ecosystems. Due to the small size of the islands of Micro-

nesia, activities conducted within watersheds have almost immediate effects on coastal coral reefs. Runoff, sedimentation and nonpoint source pollution are among the greatest threats to coral reefs throughout the Pacific Basin. The societal costs of coral reef degradation resulting from land-based developments are great, especially when considering the importance of coral reefs to island cultures. Data were collected on the classes of coastal pollutants associated with watershed discharges of greatest concern to coral reef health, on physical and chemical characteristics of coastal waters affected by watershed discharges, and a model was developed to assess the effects of runoff and sedimentation over time and space.

An assessment of the societal costs of insufficient environmental protection measures within watersheds as they affect reefs and related coastal marine resources, was performed. Protocols were developed for assessing stress on coral reef ecosystems at the sublethal level, where management intervention is still possible and practical. We developed water and substratum quality measures to guide reef recovery and restoration efforts, and appropriate educational materials to support the development of policies for integrated watershed management through community engagement.

Dr. Richmond is presently a Professor of Marine Biology at the University of Guam Marine Laboratory, where he has served on the faculty since 1986, and as Director from 1988-1991. He received a B.S. in Biology/Geology with High Distinction from the University of Rochester, an M.S. in Marine Environmental Sciences from the Marine Sciences Research Center, SUNY at Stony Brook, and a Ph.D. in Biological Sciences from the Dept. of Ecology and Evolution, SUNY at Stony Brook. Dr. Richmond has spent most of his professional career studying coral reef ecosystems in both the Caribbean and the Pacific. He is the scientific advisor to the All-Islands Group of the U.S. Coral Reef Task Force, established by Executive Order 13089, and served as a Council Member for the International Society for Reef Studies. He works closely with island community-based organizations, traditional leaders and stakeholders, and has trained over 30 Pacific Islanders in his laboratory. His research interests include coral reef ecology, marine conservation biology, ecotoxicology and integration of traditional management systems with modern approaches to resource use and protection.

Jefferey Guyse: "Assessing Preferences for Environmental Decisions with Long-Term Consequences"

The main objectives of the study were to: (1) expand previous research on discount rates for monetary consequences to non-monetary consequences (e.g., environmental or mortality impacts); (2) conduct experimental studies to discover what factors have an impact on monetary and non-monetary preferences for temporal sequences; and (3) cross-validate and generalize the experimental results with information from professional analysts to guide development of procedures that will assist policy makers in the determination of models for the temporal perceptions of different stakeholders in environmental decisions.

Results from two of the four studies will be discussed. These studies investigated time preference for air quality, near-shore ocean water quality, health, lives lost, lives saved, and money. Results suggest that time preference for money differs significantly from the other domains, and therefore "pricing-out" these domains may not be the best method to incorporate them into a decision model.

Dr. Guyse received a B.A. in Economics from California State University, San Marcos and a Ph.D. in Management from The University of California, Irvine. He is currently on the faculty of the College of Business at California State Polytechnic University, Pomona. Dr. Guyse's decision analysis research focuses on preferences over non-monetary outcomes over time. He investigates models of time preference and empirically tests their validity.

Bill Lasley: "Environmental Endocrine Disruption in Avian Species

Exposure to environmental toxicants can lead to endocrine disruption, developmental abnormalities and reproductive failure in wildlife. The lipophilic nature of many halogenated hydrocarbons (HAHs) promotes the concentrating of these toxicants in the food chain. As a consequence, HAHs have become prime candidates for causing reproductive failure and developmental defects in a wide range of species. Laboratory experiments, however, have not always demonstrated the same, or even similar, adverse effects in rodent laboratory models. The disparity between the experimental evidence and field observations has been interpreted to indicate that either the types of exposures common *in situ are* poorly replicated *ex situ,* non-murine vertebrates are more sensitive to HAHs than the murine models commonly used in the laboratory or different mechanisms of toxicity operate in different gender, life stage or species. Despite the growing evidence that birds, reptiles and amphibians are adversely affected by such environmental hazards, there are few unifying concepts to explain the cellular mechanisms that link confirmed environmental exposures to the observed developmental defects and decline in populations.

Because avian, reptilian and amphibian species utilize lipids more than other vertebrate classes for migration and reproduction, these species may be expected to be more sensitive to HAH's toxic effects on energy balance and nutrient supply for development than mammals.

In our laboratory experiments, we focused on effects of HAHs on chickens. Estrogen treatment of male birds resulted in qualitatively similar lipid profiles to those of mature laying hens, and estrogen-treated immature hens and provided a model by which to study dioxin-estrogen effects on lipid metabolism in the absence of the energetic needs of egg production. Dioxin antagonized several effects of exogenous estrogen in male chickens while estrogen enhanced TCDD toxicity in a tissue-specific manner. *In ovo* treatment led to similar changes in lipids which correlated to alterations in brain morphology.

These findings support our hypotheses that profound differences exist in the response of different species, age-stage and genders of animals to the same HAHs. As expected, the interaction of dioxin with estrogen was common to both mammals

and birds but, unexpectedly, the *nature* of the interaction in mammals and birds was quite different. More importantly, the specific adverse effects of dioxin on key lipid mobilization may explain the wide range of developmental defects that are observed in egg-laying species compared to the effects observed in eutherian species. The results of these studies underscore the importance of selecting similar and appropriate models for laboratory investigations and demonstrate the wide differences that can be expected in terms of adverse effects resulting from similar exposures with different species and genders.

Dr. Lasley received his Ph.D. in Physiology from the University of California, Davis and postdoctoral training in Reproductive Endocrinology at the University of California, San Diego. He is currently a professor in the Center for Health and the Environment, Department of Population Health and Reproduction, at the University of California, Davis. He is also a professor in the UCD School of Veterinary Medicine. Dr. Lasley's research focuses on ovarian function; early pregnancy and comparative reproductive endocrinology; wildlife reproduction; comparative reproductive endocrinology, toxicology, and epidemiology; reproduction of non-domestic species; endocrine aspects of female fertility and early pregnancy; and reproductive epidemiology. He is the Director of the Wildlife Health Center and a reviewer for 12 respected journals.

Jacimaria Ramos Batista: "The Fate and Transport of Perchlorate in a Contaminated Site in the Las Vegas Valley"

This research presents a multidisciplinary investigation involving several aspects of perchlorate contamination in Nevada. Two perchlorate plants located in the Las Vegas Valley, NV, supplied the entire perchlorate demand of the United States for its use as a rocket fuel additive. From the early 1940's to 1976, perchlorate was released to the environment by leaks in the industrial plants and by the disposal of perchlorate-containing wastes into unlined ponds. As a result, the near surface aquifer was contaminated. The contaminated groundwater seeped into the Las Vegas Wash, reaching Lake Mead and the Colorado River. The results of the research indicate that more than 70 million m^3 of groundwater are contaminated and perchlorate amounts to almost 10,000 metric tons. In addition, perchlorate has accumulated in the sediments along the Las Vegas Wash, serving as a continuous distributed source of the contaminant.

Over thirty strains of perchlorate reducing bacteria were isolated from the contaminated site. However, natural biodegradation of perchlorate was found to be limited by certain physical/chemical conditions including lack of a suitable electron donor, the presence of high nitrate and oxygen levels in the Wash and Lake Mead, and high salinity levels in the soils of contaminated sites.

Dr. Batista holds a Ph.D. in Environmental Engineering from Penn State University, an M.S. degree in Environmental Engineering from Montana Tech, and a B.S. degree in Mining Engineering from the Federal University of Ouro Preto, Brazil. She is an Associate Professor at the University of Nevada Las Vegas, where she has been on the faculty since 1997. Her research interest is in technology development for water and wastewater treatment, especially systems that combine biological and physico-chemical processes to remove contaminants, recently perchlorate, from ground and surface waters. Jointly with her students and collaborators she has published numerous peer-reviewed journal articles, book chapters, refereed conference procedures and extended abstracts, poster abstracts, and technical reports on the contaminant perchlorate.

session 3 CLEAN LAND

Asa Bradman: "Longitudinal Birth Cohort Study of Exposures and Health of Migrant Children Living in an Agricultural Community"

The UC Berkeley Center for Children's Environmental Health Research CHAMACOS project is a Community/University partnership investigating the exposures of pregnant women and children living in the Salinas Valley to pesticides and allergens. About 600 pregnant women were enrolled in the study and, to date, we have followed their children through age 24 months. Pregnant women in our population had higher urinary levels of organophosphate metabolites compared to national reference data. Metabolite levels were also higher immediately after birth, suggesting that physiological changes at birth could increase exposures to newborns. We have also found that nearby pesticide use, the presence of household members who work as farmworkers, and the consumption of fruits and vegetables were associated with higher metabolite levels in infants.

Housing quality is very poor in this population compared to the national norm, and is associated with increased pest infestations and home pesticide use. Levels of respiratory irritants and asthma triggers are also elevated compared to other populations. We plan to continue characterizing environmental exposures to these children through age 7 years and evaluate the association of adverse eurodevelopment and respiratory disease with these exposures. We will assess the relative contribution of diet to children's OP pesticide exposures in agricultural and urban communities. We also plan to investigate the role of enzymes in controlling toxicity to organophosphate in humans. Finally, we plan to expand our Community Outreach and Translation Core

to work with our community partners to address policy implications of our research findings. This presentation will provide an overview of progress to date and future plans for the CHAMACOS partnership.

Dr. Bradman holds a Ph.D. in Environmental Health Sciences from the UC Berkeley School of Public Health. He helped found, and is the Associate Director of, the Center for Children's Environmental Health Research at the University of California at Berkeley. His research focuses on young children's exposures to toxic substances. Prior to developing the Center for Children's Environmental Health Research, Dr. Bradman worked with the Environmental Health Invesigations and Childhood Lead Poisoning Prevention Branches of the California Department of Health Services (DHS) studying child cancer clusters, children's pesticide exposure, childhood lead poisoning management, and iron deficiency and children's lead exposure. Dr. Bradman has served on several local, state, and federal advisory bodies.

Gary Shaw, E.J. Lammer, S.L. Carmichael , D.M. Iovannisci, and R.H. Finnell: "Gene-Environment Interactions and Human Malformations"

Our STAR-funded project will study approximately 3000 cases of infant malformations and controls focussing on: neural tube defects, certain heart malformations, orofacial clefs (e.g., cleft palate), and defects of the intestines. We interviewed and obtained biological samples from mothers and infants to determine the pattern or fingerprint" of 40 candidate genes associated with folic acid (vitamin B1), metabolism and detoxification enzymes, and vascular development, and are currently using a 23 gene multilocus genotyping assay developed by Roche Molecular Systems.

Our research asks three questions:

1. Can we identify patterns in infant or maternal detoxification genes ("fingerprints") associated with malformations when mothers are exposed to toxicants?
2. Where there are differences in infant and maternal genes ("fingerprints") for folate metabolism, do differences in maternal folate intake (vitamin supplements) affect infant malformations?
3. Can we identify patterns in infant and maternal vascular development genes ("fingerprints") associated with malformations when mothers are exposed to vasoactive chemicals?

Preliminary results on more than 700 cases suggest that there may be a gene-nutrient interaction for (conotruncal) heart defects between certain genotypes (RFC1-reduced folate carrier 1 gene) and maternal intake of vitamins containing folic acid.

Dr. Shaw is Research Director/Senior Epidemiologist at the California Birth Defects Monitoring Program, Adjunct Professor of Epidemiology at University California, Berkeley, and Clinical Scientist at the Children's Hospital Oakland Research Institute. He has conducted epidemiologic research of human birth defects for more than 18 years. He and his collaborators have been among the leaders in the field to investigate the interplay between host susceptibility and environmental exposures in the etiologies of birth defects. Dr. Shaw has published over 150 studies.

David M. Gardiner, A. Ndayibagira, F. Grun, D. Hoppe, and B. Blumberg: "Frog Deformities: Role of Endocrine Disruptors During Development"

There is increasing evidence that wildlife populations have suffered adverse consequences from exposure to environmental chemicals that interact with components of the endocrine system. The high incidence of deformed frogs in North America, coupled with the worldwide decline in the occurrence of amphibian species, suggests that environmental modification is negatively impacting amphibian populations. The objective of this research project is to assess the significance of endocrine disruptors that activate retinoid signaling pathways for their role in causing limb developmental deformities in frogs, and to understand their mechanism of action in order to assess their implications for human health.

We have tested the effects of treating a range of stages of frog tadpoles with retinoids, and discovered that all the deformities that are observed in wild populations of frogs can be induced by experimental exposure to retinoids. Using these findings, we have established a developmental toxicology assay to screen the activity of a number of chemicals known to be present at sites where deformed frogs are found.

If environmental retinoids are the cause of frog deformities, then retinoids will be found at sites where deformed frogs are found. To test this hypothesis, we have extracted hydrophobic substances from water samples, have fractionated them by HPLC, and have discovered a fraction that activates the retinoic acid receptor (RAR).

Dr. Gardiner received his A.B. with Honors from Occidental College and his Ph.D. from Scripps Institution of Oceanography, UC San Diego. He has held numerous teaching and research positions in the University of California system, primarily at UC Irvine. Currently, Dr. Gardiner is a Research Biologist in the UC Irvine Department of Developmental and Cell Biology.

Dr. Gardiner's research interests in developmental biology have focused on limb development and regeneration in amphibian models such as frogs and salamanders, particularly the molecular basis of pattern formation and growth control. His interest in endocrine disruption and the developmental toxicology of hormonally active agents focuses on mechanisms of environmentally induced congenital malformation in amphibians, using molecular tools.

Dorothy Thornton, Neil Gunningham, and Robert A. Kagan: "The Role of General Deterrence in Corporate Environmental Behavior"

Through a survey of 233 firms in several industries, this project asks: (1) When severe legal penalties are imposed against a violator of environmental laws, do other companies in the same industry actually learn about it? (2) Does knowing about enforcement actions against Firm A induce Firms B and C to change their compliance-related behavior?

We found that only 42% of respondents could identify the "signal case." On the other hand, 89% could identify *some* enforcement actions against other firms, and 63% of firms reported having taken some compliance-related actions in response to learning about such cases. Because most firms already are in compliance (for a variety of reasons), EPA prosecutions typically serve not to enhance the *threat* of legal punishment but: (1) to *reassure* compliant firms that investment in compliance is not foolish, and (2) to *remind* them to check on the reliability of existing compliance routines.

Dr. Kagan is Professor of Political Science and Law at the University of California, Berkeley, and Director of the Center for the Study of Law and Society. His empirical research has focused on courts and litigation; comparative legal and regulatory systems; and law enforcement by regulatory agencies. His books include *Regulatory Justice* (1978); *Going By the Book* (with E. Bardach) (1982, new edition 2002); *Regulatory Encounters: Multinational Corporations and American Adversarial Legalism* (2000) (with Lee Axelrad); *Adversarial Legalism: The American Way of Law* (2001); and *Shades of Green: Business, Regulation, and Environment* (with Neil Gunningham and Dorothy Thornton) (2003).

Dr. Thornton is a Researcher at the School of Public Health at the University of California at Berkeley. Her empirical research has focused on environmental regulatory and management systems. Her books include *Shades of Green: Business, Regulation, and Environment* (with Neil Gunningham and Robert A. Kagan) (2003); *Environmental Compliance Manual for the Road and Rail Transportation Industries*, (Blymyer Engineers), McGraw Hill, 1998, and *Environmental Management Tools on the Internet: accessing the world of environmental information* (with Michael Katz, 1997).

Phillip Fine: "The Contribution of Biomass Combustion to Ambient Fine Particle Concentrations in the United States"

Biomass combustion is an important source of fine particle emissions to the atmosphere. According to USEPA emissions inventories for the year 1995, approximately 20% of total primary $PM_{2.5}$ emissions come from biomass combustion sources but do not identify specific sources. Source apportionment with chemical mass balance receptor models can determine the contribution of different fine particle source types to a particular ambient fine particle sample. The identification of individual organic compounds in the fine particle emissions from biomass combustion and other fine particle sources provides a rich source of potential molecular tracers that can be used in apportionment calculations.

A series of experiments were conducted to characterize the fine particle emissions from the following biomass combustion sources: residential wood combustion in fireplaces, non-catalytic wood stoves, and catalytic wood stoves; the prescribed burning of foliar fuels; and the open burning of agricultural waste. Results include emission factors for particle mass, organic and elemental carbon, ionic species, selected elements, and over 200 individual organic compounds. The cellulose pyrolysis product, levoglucosan, was emitted from all of the biomass combustion sources and serves as a unique tracer for biomass combustion in general.

The data from the residential wood combustion source tests were used in a chemical mass balance receptor model to determine the contribution of biomass combustion to ambient fine particle concentrations throughout the United States. The resulting national map provides seasonal and geographical information on the significance of biomass combustion as a fine particle source in the United States.

Dr. Fine received a B.S. degree in Mechanical Engineering and Materials Science and Engineering from the University of California at Berkeley, and a Ph.D. in Environmental Engineering Science at Caltech. Dr. Fine is currently an Assistant Research Professor of Environmental Engineering at the University of Southern California and is an investigator at the Southern California Particle Center and Supersite.

His research at USC includes the characterization of the detailed chemical composition of size-fractionated ambient aerosols collected with wearable personal impactors and stationary impactors to identify and apportion particulate sources.


Photo: Jim Grove

session 4 **CLEAN WATER**

Susan Anderson, A. Brooks, G. Cherr, R. Higashi, S. Morgan, R. Nisbet, and S. Ustin: "Developing Indicators of Wetland Condition in the PEEIR (Pacific Estuarine Ecosystem Indicator Research) Consortium"

The overarching objective of the project is to develop indicators of wetland condition. We emphasize assessment of toxic substances and nutrient enrichment as stressors but also include evaluations of pathogens, exotic species, and habitat fragmentation. Our consortium includes 30 faculty in a partnership among UC Davis, UC Santa Barbara, and other selected institutions. Our approach is highly integrated by use of: a common sampling design, a suite of model species, and the coupling of field and laboratory experiments with routine field censusing. The extensive integration among investigators enables cost-effective, yet rigorous, development of indicators on multiple scales across a broad geographic region with characterization of both ecological response and multiple stressors. One of the key goals of the project involves the development of indicators in wetland plants at multiple spatial scales. This is an important task, because two of the key limitations of existing ecological indicators are the lack of techniques to ascribe ecological change to specific stressors and the difficulty in prioritizing problems that may occur at large spatial scales. Novel chemical and biochemical techniques are being linked directly to plant condition. In concert, remote sensing experts assess biomass changes within the same sites at the landscape scale. A second key goal of the project is to assess, diagnose, and forecast changes in populations of resident animals within the marshes. Working with model saltmarsh species, we are coupling physiologic responses to contaminants with assessments of growth and reproduction. This will be a novel contribution because linkages between the physiology-based "early warning signals" and fitness parameters are urgently

needed. In addition, techniques that allow us to distinguish the impacts of multiple stressors in estuarine environments are required for action on many management issues. Our project team endeavors to apply findings to numerous policy issues within California including: wetland restoration in Northern and Southern California, risk assessment at mercury-contaminated sites, fish population declines, nonpoint source pesticide contamination, pathogens and beach closures, and nutrient enrichment in the coastal zone.

Dr. Anderson is Director of the Pacific Estuarine Ecosystem Indicator Research (PEEIR) Consortium and is on the research faculty at the UC Davis Bodega Marine Laboratory. Her research specialty is genetic ecotoxicology; however, her career has also been defined by a commitment to merging science and policy. Her accomplishments in this regard were acknowledged by receipt of a Pew Scholarship in Conservation and the Environment in 1992.

Geoffrey Schladow: "Characterizing Contaminant Issues in San Pablo Bay and its Environs"

San Pablo Bay and its surrounding rivers, sloughs and marshlands, is a highly complex and energetic estuarine system. We have investigated linkages between waterborne and sediment-borne contaminant fluxes and toxicity using a network of measurement stations. Measurements included continuous acquisition of physical data and monthly acquisition of chemical data. Ecological stress indicators considered included biochemical, cellular and histological indicators, benthic assemblages, contaminant bioaccumulation in fish tissue, and reproductive success for two bird species.

The results suggest that spatial and temporal variations in the San Pablo Bay system are discontinuous, and that characterizing such a system requires *a priori* knowledge of where and when to conduct sampling. Whereas many of our sampling locations yielded information similar to a parallel State of California Regional Monitoring Program, the greater intensity of our observations allowed for a vastly different picture of contaminant transport and flux to emerge. Some specific examples will be discussed.

Dr. Schladow has been a Professor at UC Davis since 1993. He has a Master's in Engineering from UC Berkeley, a Ph.D. from the University of Western Australia. His research interests center on the interaction between fluid mixing processes and the determinants of water quality and ecological well-being, using a combination of modeling, field and laboratory techniques. Projects receiving EPA funding include: CISNET – San Pablo Bay; Oxygen Transfer Across an Air-water Interface; 3-D Modeling of Currents in Clear Lake California; and Lake Tahoe Clarity Model.

Kamini Singha: "Applicability of Electrical Resistivity Tomography to Estimate Subsurface Heterogeneity of Hydrogeologic Parameters"

Understanding how water moves through the subsurface is an important factor in designing cleanups for sites with contaminated groundwater. Electrical resistivity tomography (ERT) was evaluated as a method to provide spatially continuous images of saline tracer concentrations during transport through unconsolidated fluid-saturated media. Field data were collected at the Massachusetts Military Reservation, Cape Cod, Massachusetts. A 20-day weak-dipole tracer test was conducted.

The tomograms indicate movement of the saline tracer over time and space that is consistent with measured concentration data. The magnitude of the tracer concentration, however, was underestimated due to scaling effects, geophysical regularization, and an averaging process. To use the geophysical data quantitatively, calibration of the resistivity tomograms with respect to known concentrations of tracer (or contaminant) is required. By accounting for the expected geophysical response, the ERT data may serve as a surrogate for concentration maps that are otherwise impossible to obtain. Such maps can serve as data to help delineate aquifer heterogeneity.

Kamini Singha is a Ph.D. candidate in the Department of Geological and Environmental Sciences at Stanford University with an emphasis in hydrogeology. She received her B.S. with Honors in Geophysics from the University of Connecticut. She worked for the Branch of Geophysics in the U.S. Geological Survey from 1997-2000. She was made an Environmental Protection Agency STAR Fellow in 2000, and her work was awarded a National Science Foundation Grant in 2002. Her research objectives are to develop systematic procedures capable of delineating spatially variable aquifer hydraulic property values through integrated analysis of geophysical data with hydrologic data.